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from: R. A. Bass, L. P. Gieseler, M. T. Yates

subject: Trip Report: Meeting at MSC on May 4, 1971 to Discuss S-IVB Lunar Impact Targeting Philosophy -- Case 310

MEMORANDUM FOR FILE

A meeting was held at MSC on May 4, 1971 to discuss the targeting procedure for impacting the spent S-IVB stage at a specified site on the moon. The meeting was attended by representatives of MSC, MSFC, and by Dr. Gary Latham, the principal investigator for the Passive Seismic Experiment. Bellcomm representatives were R. A. Bass, M. T. Yates, and L. P. Gieseler.

Review of AS-508 and AS-509 Targeting Constraints and Preferences

Mr. McFadden of MSFC reviewed the strategy used for Apollo 14 (Attachment 1) which significantly does not include the APS-2 maneuver in the nominal sequence. MSFC considered the job complete if the predicted impact was within 200 km of the target.

LOX Dump and APS-1 Targeting and Error Analysis for Apollo 15

Mr. McFadden also described the MSFC current targeting strategy for the LOX Dump and APS-1 maneuver. The LOX Dump will be done with a -40° yaw and 209° pitch and should put the post-dump impact point near 60°W and 22°S (Attachment 2). The post dump 3σ error ellipse is shown in Attachment 3, approximately 700 by 2600 km. The first APS burn (-25° yaw and 191° pitch) would take place 44 minutes later targeted to the desired impact point (3.65°S - 7.58°W). The resulting 3σ error is approximately a circle having a radius of about 320 km. The second APS burn, not nominally scheduled, would take place about 2-3/4 hours later. The resulting 3σ error is approximately a circle having a radius of about 55 km. Most of the post APS-2 error is due to inaccuracies in the determination of the state vector by the MSFN tracking system.

P.I. Comments

Dr. Latham reported that the results from the Apollo 14 S-IVB impact will be severely degraded because it was too close to the seismometer stations. He said a 350 km uncertainty in the target point is much too large and that two APS burns should definitely be planned to reduce this uncertainty to an absolute minimum (∿50 km). Dr. Latham agreed with the priorities documented in M. T. Yates memo (B71 04048). Figure 1 (Attachement 4) presented therein provided the focal point for the subsequent discussions on improving the targeting procedure.

Improved Targeting Procedure for Apollo 15

There was considerable discussion of how to target the Apollo 15 S-IVB for various contingency situations. The procedure that was worked out and agreed to by Dr. Latham is as follows:

1. Target the first APS burn to 3.65° south and 7.58° west.

2. Target the second APS burn to the same target if the predicted 3σ uncertainty of impact is less than 100 km.

3. If the 3σ uncertainty of impact is greater than 100 km, target the second APS burn 3.65° south but 2.58° west, five degrees east of the nominal target.

4. If it is impossible to achieve the desired target with the second APS burn, then target to a site that first has a range to either ALSEP near 300 km and second has latitude as close as possible to 3.65°S.

R. A. Bass

L. P. Gieseler

M. T. Yates

2013-RAB
2013-LPG-jab
2015-MTY

Attachments

ATTACHMENT 1

AS-508 AND AS-509
TARGETING CONSTRAINTS AND PREFERENCES

1. No more than two APS burns following LOX dump.
2. Last APS burn no later than 10 hours GET.
3. Avoid multiple commands.
4. The following times are required:
   a. 15 minutes from the time track is broken to the time vector is received.
   b. 20-30 minutes for targeting.
   c. 15 minutes for verification and uplink of command.

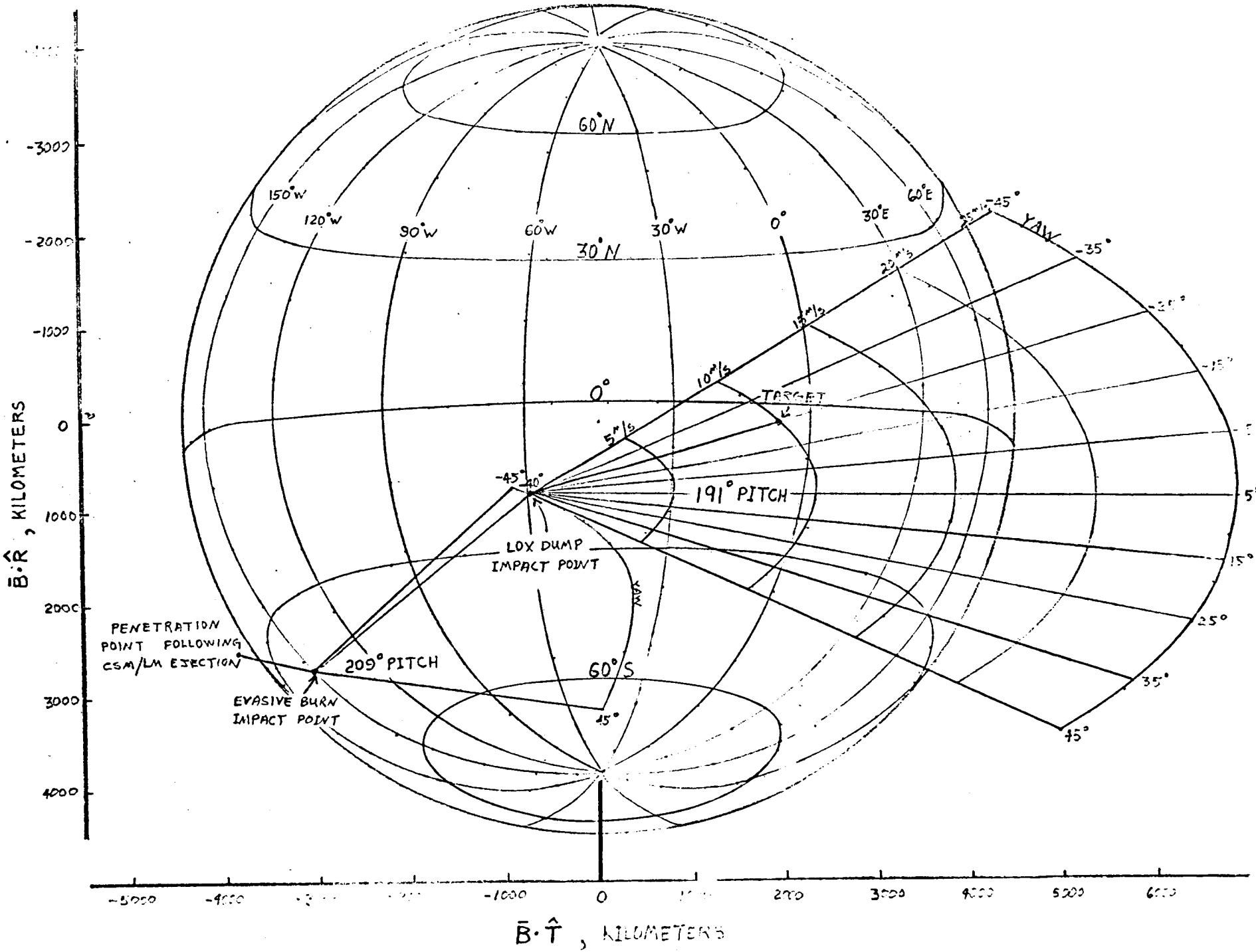
   \+ _____

   50-60 minutes from the time track is broken until start of APS burn.
5. Minimum of 2 hours required for acceptable tracking accuracy, 2:30 - 2:45 preferred.
6. Real time targeting objective:

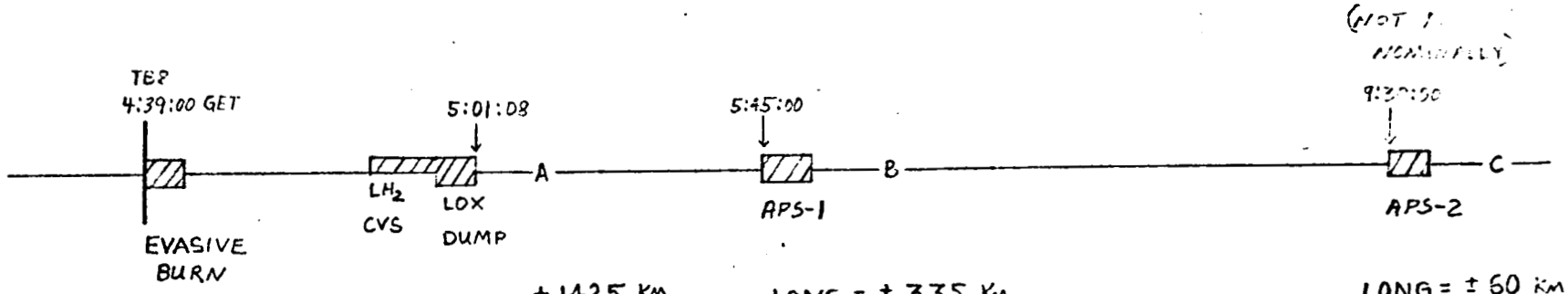
   a. Maneuver S-IVB to target with first APS burn using best available information.

   b. Wait for tracking vector following first APS burn. If tracking vector indicates that vehicle will impact within 200 km - radius - circle of target then, considering the accuracy of this vector, there is a high probability that the final impact point will be within 350 km radius of the target. At this point, the lunar impact targeting objective as outlined in the NASA Headquarters MIP has been met.

   If the tracking vector indicates that the impact point is outside the 200 km circle then a second APS burn based on the tracking vector will be performed.



ATTACHMENT 2



LONG = +1425 Km
-1185 Km
LAT = ± 335 Km

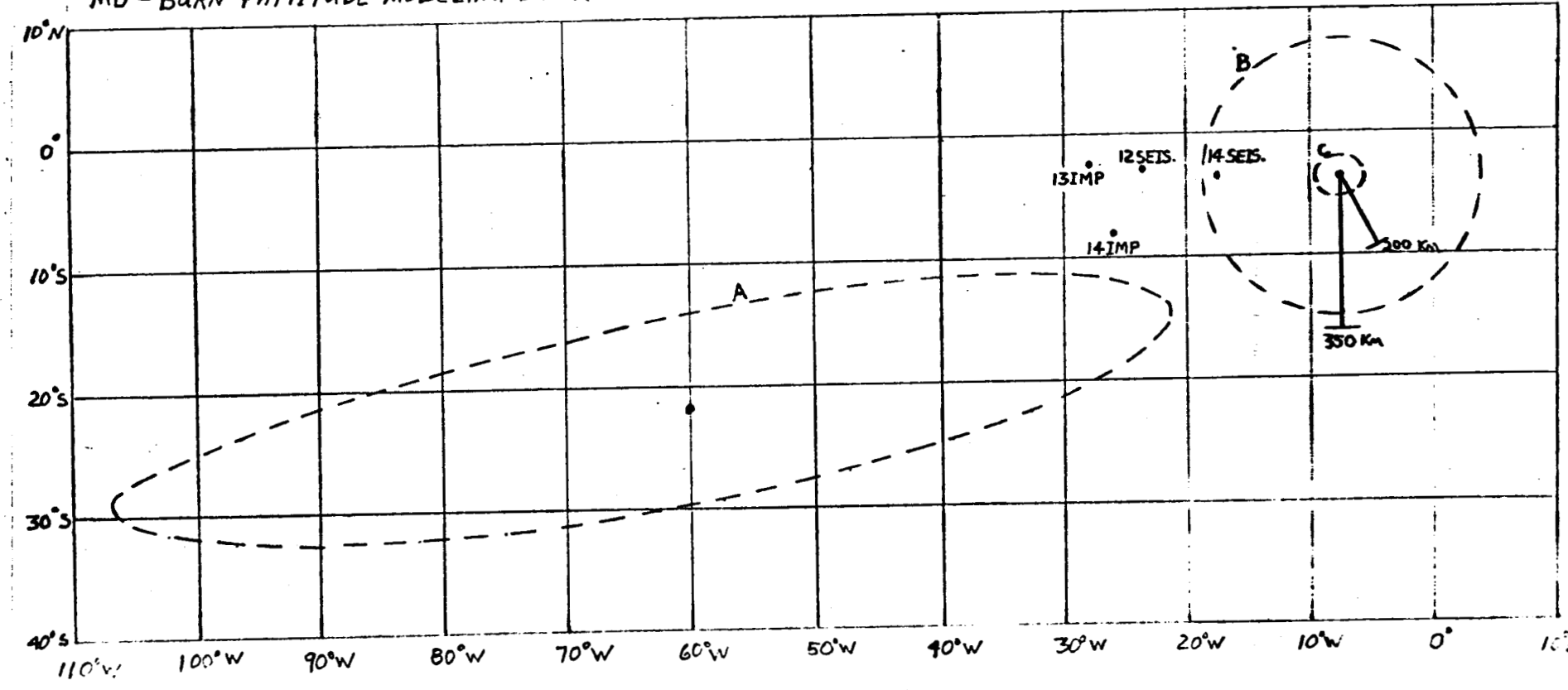
LONG = ± 335 Km
(320 IF, 103 MD)
LAT = ± 325 Km
(320 IF, 32 MD)

LONG = ± 60 Km
(56 TR, 15 MD.
LAT = ± 50 Km
(47 TR, 5 MD.

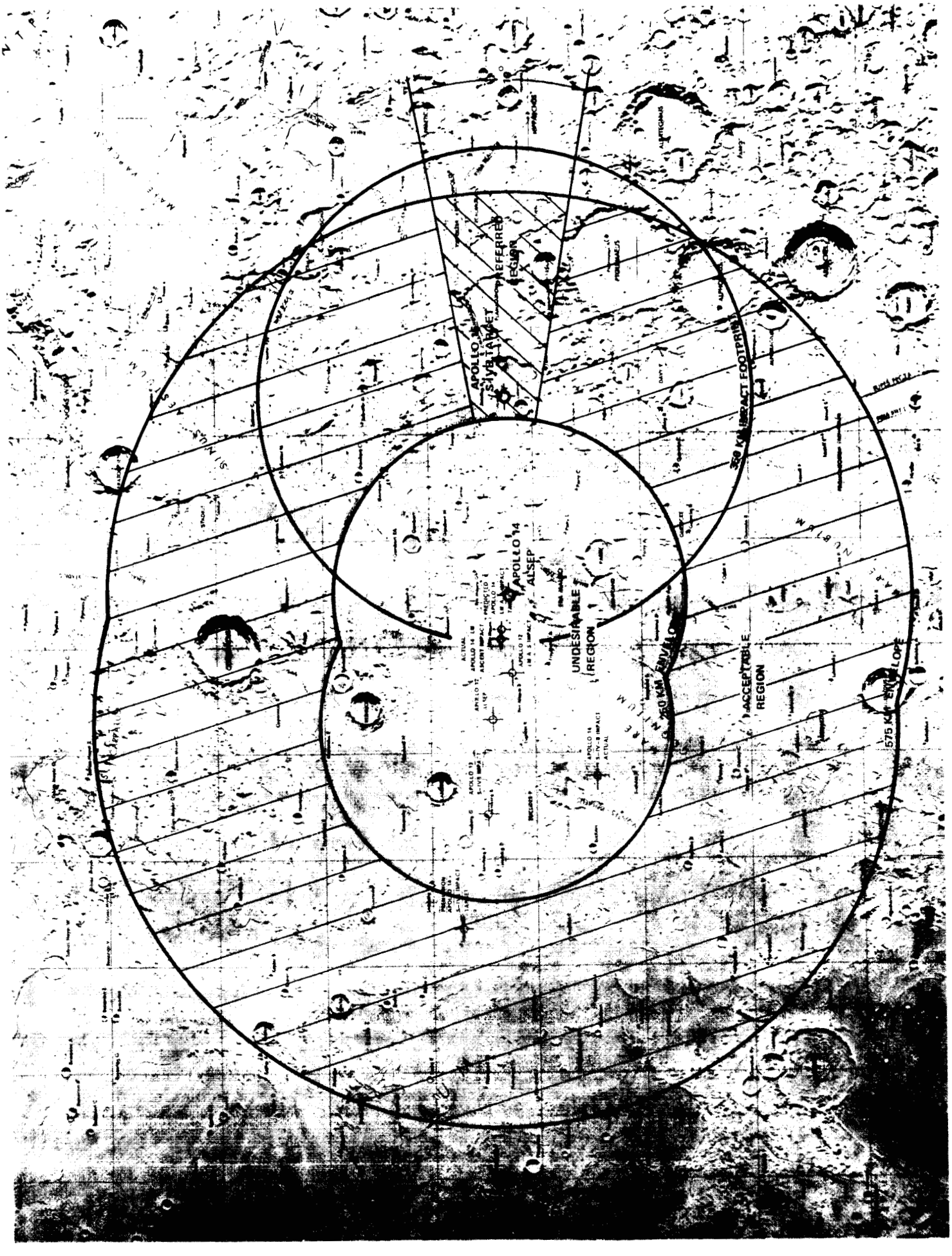
IF – IFTT RECONSTRUCTED VECTOR ERROR

TR – MSC 2 hr 45 min TRACK ERROR

MD – BURN & ATTITUDE MODELING ERROR



ATTACHMENT 3



TARGETING REGIONS FOR THE S-IVB

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From: R. A. Bass, L. P. Gieseler, M. T. Yates

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